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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/833,078	04/12/2001	David A. Thompson	45-35	1456

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EXAMINER
LOUIE, WAI SING

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 12/18/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/833,078	THOMPSON ET AL.	
	Examiner	Art Unit	
	Wai-Sing Louie	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *amendment filed 10/9/02* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16 and 22-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16 and 22-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

a. In claim 1, line 11, it is unclear what is meant by "slow diffusers".

b. In claim 1, line 15, it is unclear what is meant by "fast diffusers".

c. In claim 8, line 3, it is unclear what is meant by "deep states".

d. In claim 14, line 3, it is unclear what is meant by "point defects".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-4 and 8-16 (in so far as they are understood) are rejected under 35 U.S.C. 103(a) as being unpatentable over Takiguchi et al. (US 5,671,242) in view of Haysom et al (IEEE Catalog#00CH37107 page 56-59) and Elman et al. (US 5,238,868).

With regard to claims 1 and 3, Takiguchi et al. disclose the method of manufacturing a quantum well structure (col. 5, line 15 to col. 11, line 17 and fig. 1) comprising:

- Providing a quantum well structure comprising an indium gallium arsenide phosphide (InGaAsP) quantum well active region (col. 5, lines 17-34 and fig. 1);
- Takiguchi et al. disclose an InP containing layer 13b, but do not disclose providing the layer with vacancy type defects on top of the quantum well structure. However, Elman et al. disclose by inter-diffusing the vacancies from the created disordered region 11 into the quantum well active region (Elman col. 2, lines 44-47). Elman et al. teach the quantum well bandgap could be tuned by this intermixing technique without inducing defects or causing damages into the quantum well (Elman col. 2, lines 47-53 and 10-14). Therefore, it would have been obvious to one with ordinary skill in the art to modify Takiguchi's device with the teaching of Elman et al. to use the quantum well intermixing technique. Doing so could tune the bandgap of the quantum well active region without causing damages in the active region;
- Takiguchi et al. disclose an InP layer 4, but do not disclose providing the layer with interstitial type defects on top of the quantum well structure. However, Haysom et al. disclose an InP upper layer created a surplus of phosphorus interstitial defect (page 56, first paragraph). Haysom et al. teach the quantum well intermixing technique creating a surplus of lattice defects in selected areas resulting a blue shift, which increases in energy (page 56, right column). Therefore, it would have been obvious to one with ordinary skill in the art to

modify Takiguchi's device with the teaching of Haysom et al. to use the quantum well intermixing technique in order to create a blue shift;

- Takiguchi et al. do not disclose applying a rapid thermal annealing (RTA) process for controlling diffusion of the vacancy type and interstitial type defects into the InGaAsP quantum well active region. However, Takiguchi et al. modified by Elman et al. and Haysom et al. above would have an InP layer containing vacancy defect and another InP layer containing interstitial defects. Both Elman et al. and Haysom et al. disclose RTA to generate inter-diffusion of defects into the quantum well active region (Elman col. 2, lines 44-47 and col. 4, lines 20-22; Haysom page 56, right column). Therefore, it would have been obvious to one with ordinary skill in the art to modify Takiguchi's device with the teaching of Haysom et al. to thermal anneal the structure in order to generate the quantum well intermixing.

With regard to claims 2, 4, and 13, Takiguchi et al. do not disclose the InP layer is epitaxial grown by means of molecular beam epitaxy (MBE). However, it is common in the art to select the MBE, which is the best technique to form the semiconductor compound including the selected defects in the layer, such as disclosed in Elman et al (Elman col. 4, line 7).

With regard to claim 8, Takiguchi et al., modified by Elman et al. in claim 1 above, disclose the vacancy type of defects in the first indium phosphide layer. Elman et al. disclose the inter-diffusion into the InGaAsP quantum well active region and tune the bandgap energy of quantum well (Elman col. 2, lines 24-29).

With regard to claims 9-11, Takiguchi et al. do not disclose the deep states provide reduced carrier lifetimes, or the reduced carrier lifetimes provide a reduction in carrier recombination times, or the deep states provide a mechanism for quenching photoluminescence within the bandgap of the InGaAsP quantum well active region. However, the process of using limitation, in a method prosecution, does not carry any patentable weight.

With regard to claim 12, in addition to the limitations disclosed in claim 1 above, Takiguchi et al. modified by Elman et al. and Haysom et al. also disclose:

- Takiguchi et al. do not disclose the acceptor-like indium vacancies. However, Elman et al. disclose Group III element across the heterostructure interface (Elman col. 1, lines 21-22). Indium is a Group III element. Therefore, it is obvious the intermixing technique inter-diffuses the acceptor-like indium vacancies.

With regard to claim 14, Takiguchi et al. do not disclose the plasma assisted epitaxial growth by means of a reduced temperature MBE process. However, Takiguchi et al., modified by Haysom et al. in claim 1 above, would disclose the InP layer having interstitial defects. Haysom et al. disclose the defects are grown-in the reduced temperature (page 56, first paragraph).

With regard to claims 15-16 and 23-24, Takiguchi et al. do not disclose the thickness of the InP layer is in a range of 0-140 nm. However, since the applicant has not established the criticality of the thickness stated and since this thickness are in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use this value in the device of the thickness. Where patentability is said to be based upon particular chosen dimension

or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). Haysom et al. disclose the annealing is done in a single thermal anneal step (Haysom page 56, right column).

Claims 5-7 (in so far as they are understood) are rejected under 35 U.S.C. 103(a) as being unpatentable over Takiguchi et al. (US 5,671,242) in view Yamazaki et al. (US 5,923,968).

With regard to claims 5-7, Takiguchi et al. do not disclose growing the first InP layer with helium-plasma assisted MBE or disclose exposing the InP layer to a flux of helium particles to produce the vacancy defects. However, Yamazaki et al. disclose using helium plasma treatment to deform the crystalline (Yamazaki col. 12, lines 40-45). Yamazaki et al. teach the helium plasma treatment MBE process could produce extremely high crystallinity film (Yamazaki col. 12, lines 32-38). Therefore, it would have been obvious to one with ordinary skill in the art to use helium-plasma assisted MBE to form the first InP layer in order to produce a high crystallinity film.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Takiguchi et al. (US 5,671,242) in view Freundlich et al. (US 5,851,310).

With regard to claim 22, Takiguchi et al. do not disclose the InP layer is grown by means of a reduced temperature MBE process at a temperature of 300 °C. However, Freundlich et al. disclose the condition of growth by MBE system (Freundlich col. 4, line 49) at a lower temperature of 300 °C (Freundlich col. 6, line 39). Freundlich et al. teach the low temperature

prevents the degradation of the characteristic (i.e., uniformity in composition or thickness) of the semiconductor layer (Freundlich col. 4, lines 30-46). Therefore, it would have been obvious to one with ordinary skill in the art to modify Takiguchi's device with the teaching of Freundlich et al. to provide a low temperature of 300 °C in order to produce a uniform semiconductor layer.

Response to Arguments

Applicant's arguments filed 10/9/02 have been fully considered but they are not persuasive.

- Applicant does not provide answer to the 35 U.S.C. 112 rejection. Applicant argues that is common in the art. However, how slow is slow; how fast is fast; and how deep is deep. A clear definition is needed. The 35 U.S.C. 112, second paragraph rejection remains as stated.
- Applicant argues that Takiguchi et al. disclose a quantum well structure, the vacancy type and interstitial type defects have to rely on Elman et al. and Haysom et al. The combination of these references is based on hindsight reconstruction of the invention of present application. However, Takiguchi et al. provide a common LED having a quantum well active region, but Elman et al. teach a way to tune the bandgap of the quantum well active region without causing damages in the active region; and Haysom et al. teach the quantum well intermixing technique creating a surplus of lattice defects in selected areas resulting a blue shift, which

increases in energy. These provide the motivation for one with ordinary skill in the art to modify Takiguchi's device. Therefore, the combination is proper.

- Applicant argues that Takiguchi et al. do not recite the low temperature MBE growth. However, the temperature range is not listed in claim 1.
- Applicant argues that Takiguchi et al. do not disclose the correct thickness of the InP layer as outlined in claims 15 and 16. The rejection above stated that the thickness is an optimized design choice. Therefore, it is obvious to one of ordinary skill in the art to use these values in the device.
- Applicant argues that the limitation of providing helium plasma assisted MBE is not disclosed. However, Takiguchi et al. modified by Yamazaki et al. in claims 5-7, disclose the helium plasma assisted MBE (Yamazaki col. 12, lines 40-45). Please see the rejection above.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

LONG PHAM
PRIMARY EXAMINER

wsl
December 11, 2002